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Relationship of body condition score (BCS), physical and post-mortem parameters with live body weight and dressing percentage in Nellore Brown ewes

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Abstract
This study aimed to investigate the relationship between body condition score (BCS), physical parameters, and post-mortem characteristics with live body weight and dressing percentage in Nellore Brown ewes. The data were collected from ewes slaughtered at a specific slaughterhouse in Banaganapalle, Andhra Pradesh, India. Various physical measurements, including height, body length, thoracic circumference, and live body weight, were recorded. Post-mortem parameters such as drained blood weight, skin weight, weight of gastrointestinal (GI) tract, weight of visceral organs, weight of separated head and shanks, and hot carcass weight were also measured. The results showed that physical parameters, including height, body length, and thoracic circumference, generally increased with an increase in BCS. Similarly, live body weight and hot carcass weight increased significantly with higher BCS. However, no consistent pattern was observed for post-mortem parameters in relation to BCS. Correlation analysis revealed that certain physical and post-mortem parameters had positive and significant relationships with live body weight and dressing percentage in specific BCS categories. These findings highlight the importance of managing BCS in Nellore Brown ewes to optimize meat production efficiency and carcass quality.

Keywords: Body condition score, Dressing percentage, Physical parameters, Post-mortem parameters and Nellore Brown sheep

Introduction
Nellore Brown sheep breed is primarily found in the Nellore region of India. Nellore Brown sheep are characterized by their medium to large-sized frame, with a strong and muscular build (Acharya *et al.* 2018) [1]. These sheep are predominantly raised for meat production due to their excellent growth rates, efficient feed conversion, and desirable meat quality attributes (Santos *et al.* 2020) [22]. Body Condition Score (BCS) is a widely used tool in livestock management for assessing the nutritional status and body condition of animals. It is typically scored on a numerical scale ranging from 1 to 5 or 1 to 9, with higher scores indicating greater fatness (Hinch *et al.* 2014) [10]. BCS is influenced by various factors, including nutrition, genetics, age, physiological state, and environmental conditions (Keady *et al.* 2012) [12]. Dressing percentage reflects the proportion of meat obtained from a live animal after it has been slaughtered and dressed (García *et al.* 2012) [7]. This parameter serves as a crucial indicator of the efficiency of meat production and can vary depending on factors such as breed, age, sex, and body condition (Mushi *et al.* 2009) [16]. The present study was conducted on Relationship of BCS, physical and post-mortem parameters with live body weight and dressing percentage in Nellore Brown ewes with the following objectives.

- To evaluate dressing percentage in the ewes of Nellore Brown sheep of different BCS
- To study relationship of physical parameters with live body weight and dressing percentage in Nellore brown ewes
- To study relationship of BCS with live body weight and dressing percentage in Nellore Brown ewes.

Materials and Methods

The study was conducted at slaughter house of Banaganapalle of Nandyal District, Andhra Pradesh during January to April 2023. Data was collected from the ewes of 3-4 year age of Nellore brown ewes that slathered during the study period in the slather house at Banaganapalle. The sample animals were selected using purposive random sampling method. Pre slaughter data on body measurements *viz*. body length, height at withers, circumference at chest region and live body weight was collected using measuring tape and digital weighing balance. The post mortem parameters *viz*. weight of drained out blood, skin, visceral organs, GI tract, shanks, separated head and weight of hot carcass was collected using digital weighing balance. The data was tabulated and analysed for significance and correlation coefficients using SPSS.

Results and Discussion

The sample of ewes for the study distributed according to age and BCS and presented in table 1. The data clear indicated that majority of the ewes of 3-4 year age were of BCS of 4.0 (41.7%) followed by BCS 2.0 (38.3%) and BCS 3.0 (20%).

Table 1: Distribution of ewes of 3-4 years of age according to BCS

S.No	BCS	Number of ewes	%
1	2.0	23	38.3
2	3.0	12	20.0
3	4.0	25	41.7
		60	100

Physical parameters

The physical parameters *viz*. height, body length, circumference at thoracic region and live body weight in the Nellore Brown ewes of 2-5 years of age. The data presented in table 2 it was observed that the almost similar mean height of the ewes was recorded in BCS 4.0 and 3.0 as 28.4±0.28 and 29.91±0.37 followed by 27.16±0.34 inches in the ewes with BCS of 2.0.

The body length of Nellore Brown ewes was ranged from 22.83±0 to 24.97±0.34 inch. The height body length was recorded in the ewes with BCS 4.0 and lowest was observed in the ewes with BCS 2.0. It was observed that the body length of ewes increased with the increase in BCS from 2.0 to 4.0.

The circumference at thoracic region of Nellore Brown ewes was ranged from 26.9±0.39 to 30.1±0.43 inch. The height circumference was recorded in the ewes with BCS 4.0 and lowest was observed in the ewes with BCS 2.0. It was observed that the circumference of ewes increased with the increase in BCS from 2.0 to 4.0.

The live body weight of Nellore Brown ewes was ranged from 22.79±1.13 to 29.94±0.86 kg. The height live body weight was recorded in the ewes with BCS 4.0 and lowest was observed in the ewes with BCS 2.0. It was observed that the live body weight of ewes increased with the increase in BCS from 2.0 to 4.0.

These observations highlight the relationship between BCS and various physical parameters in Nellore Brown ewes. Higher BCS values were generally associated with increased body length, thoracic circumference, and live body weight. These findings align with previous studies that have reported positive correlations between BCS and body weight in sheep (Oliveira *et al*. 2019 & Souza *et al.* 2018) [18, 23].

Table 2: Physical parameters of ewes of BCS varies from 2.0 – 5.0

Parameter	BCS 2.0 n=23	BCS 3 n=12	BCS 4 n=25
Height	27.16±0.34	29.91±0.37	28.4±0.28
Length	22.83±0.35	23.78±0.43	24.97±0.34
Heart girth	26.9±0.39	29.13±0.38	30.1±0.43
Live body weight	22.79±1.13	27.0±0.82	29.94±0.86

Post mortem parameters

The data on post-mortem parameters *viz*. weight of drained out blood, skin, GI tract, Visceral organs, separated head and shanks and hot carcass weight is presented in table 3. The data clearly indicated that the weight of the drained-out blood in the Nellore Brown ewes was ranged from 0.73±0.07kg to 0.78±0.05kg. The highest weight of the blood was recorded in the ewes with BCS 4.0 followed by almost equal values observed in BCS of 2.0 and BCS of 3.0. It was observed that the weight of drained-out blood was not increase with the increase in BCS.

The weight of skin after skinning in the Nellore Brown ewes of 1 year age was ranged from 2.59±0.1kg to 3.23±0.13kg. The highest mean weight of skin was recorded in the ewes with BCS 4.0 followed by almost equal values observed in BCS 3.0 and 2.0. It was observed that the weight of skin was not increase with the increase in BCS.

The weight of the GI tract with the ingesta was highest in the ewes with BCS 2.0 (5.54±0.34kg) and lowest was recorded in the ewes with BCS 4.0 (5.38±0.27kg). It was observed from the data that significant improvement in the weight of GI tract with decreased with increase of BCS from 2.0 to 4.0 of Nellore Brown rams.

The weight of visceral organs consisting of lungs, liver, spleen and heart was recorded in the slaughtered Nellore Brown rams. The data indicated that the highest weight was recorded in the ewes with BCS 4.0 (0.99±0.08kg) followed by BCS 3.0 (by 0.93±0.15kg) and BCS 2.0 (0.93±0.15kg). It was observed that the weight of the visceral organs was not increase with the increase in BCS.

The weight of the separated head and shanks of four legs in the slaughtered Nellore Brown ewes was highest in the animals with BCS 3.0 (2.73±0.13kg) followed by BCS 4.0 (2.58±0.11kg) and BCS 2.0 (2.58±0.11kg). It was observed significant increase in the weight of separated head and shanks with increase in BCS from 2.0 to 4.0. It was observed that the weight of the separated head and shanks was not increase with the increase in BCS.

The hot carcass weight of slaughtered Nellore Brown ewes was highest in the animals with BCS 4.0 (15.23±0.68kg) followed by BCS 3.0 (13.35±0.39) and BCS 2.0 (10.25±0.54kg). It was observed that the hot carcass weight increased significantly with the increase in the BCS from 2.0 to 4.0.

Overall, the data on post-mortem parameters suggest that BCS may have varying effects on different parameters. While some parameters showed significant associations with BCS, others did not exhibit consistent trends. These findings align with previous studies that have reported varying relationships between BCS and carcass characteristics in different sheep breeds (Ghiasi-Galougahi *et al*. 2021 & Safdar *et al.* 2019) [8, 19].

Table 3: Post-mortem parameters of ewes of BCS varies from 2.0 – 4.0

Parameter	BCS 2.0 n=23	BCS 3 n=12	BCS 4 n=25
Weight of the drained-out blood	0.78±0.05	0.73±0.07	1.29±0.06
Weight of the skin	2.59±0.1	2.63±0.12	3.23±0.13
Weight of GI tract	5.54±0.34	5.37±0.28	5.38±0.27
Weight of visceral organs	0.93±0.15	0.93±0.15	0.99±0.08
Weight of head and shanks	2.58±0.11	2.73±0.13	2.58±0.11
Hot carcass weight	10.25±0.54	13.35±0.39	15.23±0.68

Relationship of physical and post-mortem parameters with the live body weight of Nellore Brown ewes with BCS from 2.0 to 4.0.

The data on correlation coefficients of physical and post-mortem parameters with live body weight was presented in Table 4. The data clearly indicated that the live body weight of ewes with BCS 2.0 was positive and significant relationship (p<0.01) of heart girth, drained out blood, visceral organs and same relation (p<0.05) also with weight of skin, GI tract, weight of head and shanks and hot carcass weight. These findings align with previous studies that have reported positive correlations between live body weight and carcass characteristics in sheep (Bhatta *et al.* 2020 & Ghiasi-Galougahi *et al.* 2021) [3, 8]. This suggests that higher live body weights in ewes with BCS 2.0 are associated with increased values of these post-mortem parameters (Ali *et al.* 2017) [2].

The live body weight in the ewes with BCS 3.0 had positive and significant (p<0.01) relation with weight of the GI and whereas positive and relationship (p<0.05) was observed with visceral organs, weight of the head and shanks and hot carcass weight. But negative and non- significant relation with drained out blood in the ewes. This implies that increased live body weight in ewes with BCS 3.0 is positively related to these post-mortem parameters, except for drained-out blood (Nawab *et al.* 2017) [17].

Among the ewes with BCS 4.0, live body weight had positive and significant (p<0.01) relation with length and significant relation (p<0.05) also with height, heart girth, drained out blood, skin, GI tract and hot carcass weight and non-relation was observed between live weight and weight of the visceral, weight of the head and shanks was observed. This suggests that higher live body weights in ewes with BCS 4.0 are positively associated with these post-mortem parameters, while weight of the visceral organs and head and shanks may not be significantly influenced by live body (Dhakad *et al.* 2015) [6].

These findings emphasize the importance of Body Condition Score (BCS) in predicting the post-mortem characteristics of Nellore Brown ewes. Higher live body weights were generally associated with increased values of various post-mortem parameters, reflecting a potential increase in meat yield. These results are consistent with previous studies that have reported similar relationships between live body weight and post-mortem parameters in different sheep breeds (Oyedipe *et al.* 2019 & Hossain *et al.* 2018) [19, 11].

The relationships observed between live body weight and various parameters in different BCS categories highlight the complexity of body composition and carcass traits in sheep. These findings align with previous research that has reported similar relationships between live body weight and body measurements in different sheep breeds (Kamble *et al.* 2020 & Hanušová *et al.* 2021) [9, 12].

Relationship of physical and post-mortem parameters with the dressing percentage of Nellore Brown ewes with BCS from 2.0 to 4.0

The data presented in Table 5 revealed that the dressing percentage of the ewes with BCS 2.0 had positive and non-significant relation was observed with length, heart girt, drained out blood and hot carcass. But negative and significant relation (p<0.05) with the visceral organs and whereas negative and non-relation with height, weight of the skin, weight of the GI tract and weight of the head and shanks. However, a negative and significant relationship was found with weight of the visceral organs. No significant relationships were observed between dressing percentage and height, weight of the skin, weight of the GI tract, and weight of the head and shanks (Bhojne *et al.* 2020, Nawab *et al.* 2017 & Vijayakumar *et al.* 2014) [4, 17, 24].

It was observed that the dressing percentage in the ewes with BCS 3.0 had positive and non-significant relationship of dressing percentage was observed with height, length, heart girth, weight of the head and shanks, and hot carcass weight. But negative and significant relation (p<0.05) with the GI tract and non- significant relation was observed with drained out blood, weight of skin and weight of the visceral organs. However, a negative and significant relationship was observed with weight of the GI tract. No significant relationships were found between dressing percentage and drained-out blood, weight of the skin, and weight of the visceral organs (Deshmukh *et al.* 2021 & Kumaresan *et al.* 2013) [5, 14].

The dressing percentage in the ewes with BCS 4.0 had positive and significant (p<0.01) relation with height and heart girth and positive and significant (p<0.05) relation also with hot carcass weight non- significant relation was observed between length, drained out blood, weight of the skin, weight of the head and shanks was observed. Negative and significant (p<0.01) relation was observed with weight of the visceral organs and negative and non- significant relation with GI tract. However, a negative and significant relationship was observed with weight of the visceral organs (Makwana *et al.* 2018 & Purohit *et al.* 2018) [15, 20].

Table 4: Correlation between physical parameters and carcass yield with live body weight and dressing percentage of ewes with BCS of 2.0 - 4.0

Parameter	Live body weight			
	BCS 2.0 n=23	BCS 3 n=12	BCS 4 n=25	Pooled data n=60
Height	0.398	0.491	0.657**	0.577**
Length	0.188	0.344	0.409*	0.501**
Heart girth	0.487*	0.524	0.727**	0.730**
Blood	0.515*	-0.297	0.566**	0.599**
Skin	0.785**	0.542	0.763**	0.782**
GI tract	0.817**	0.649*	0.587**	0.547**
Visceral organs	0.444*	0.740**	0.094	0.357**
Head and legs	0.768**	0.775**	0.182	0.592**
Hot carcass weight	0.962**	0.929**	0.832**	0.914**

Table 5: Correlation coefficients between dressing percentage and physical parameters, weight of body parts, ingesta and hot carcass weight in the ewes with BCS of 2.0 – 4.0

Parameter	Dressing (%)			
	BCS 2.0 n=23	BCS 3 n=12	BCS 4 n=25	Pooled data n=60
Height	-0.176	0.321	0.444*	0.355**
Length	0.141	0.480	0.287	0.412**
Heart girth	0.023	0.193	0.407*	0.475**
Blood	0.116	-0.511	0.215	0.325*
Skin	-0.195	-0.550	0.189	0.195
GI tract	-0.302	-0.821**	-0.243	-0.269*
Visceral organs	-0.639**	-0.478	-0.412*	-0.308*
Head and legs	-0.374	0.099	0.131	0.208
Hot carcass weight	0.290	0.067	0.813**	0.731**

Conclusion

Overall, these findings emphasize the importance of considering BCS as a determinant of physical and post-mortem parameters, live body weight, and dressing percentage in Nellore Brown ewes. Managing and optimizing BCS can have implications for sheep farming systems in terms of flock health, meat production efficiency, and carcass quality.

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